



Building a Bright Future
for Humanity
共創人類美好未來



YCYW Particle Physics Masterclass

An initiative of our unique YCYW Educational Futures Programme

Year 9 – 13 | Grade 8 – A2
Particle Physics Masterclass
19 and 26 September 2024

Discover the Building Blocks of the Universe:

Join us for an exciting journey into the world of particle physics! This masterclass offers a unique opportunity to explore the smallest building blocks of the universe and the fundamental forces that govern their interactions.

What is Particle Physics?

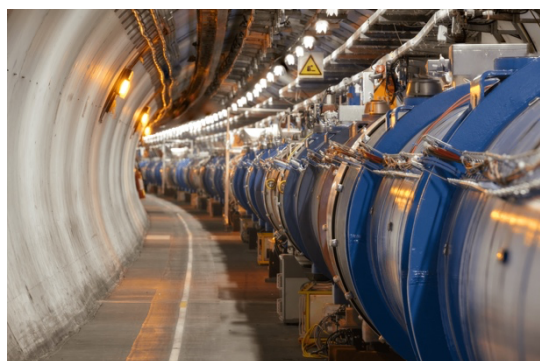
Particle physics is the study of the most basic elements of matter and energy. It seeks to answer fundamental questions such as: What is everything made of? How do tiny particles interact to form the universe?

The Standard Model

Our understanding of particle physics is based on the **Standard Model**, which includes:

- **Fundamental Particles:** Quarks (which form protons and neutrons) and leptons (such as electrons and neutrinos).
- **Fundamental Forces:** Gravitational, electromagnetic, strong nuclear, and weak nuclear forces.

While the Standard Model is incredibly successful, it doesn't include gravity as explained by general relativity, nor does it fully explain dark matter and dark energy.



Cutting-Edge Research:

Learn about groundbreaking research at world-renowned facilities:

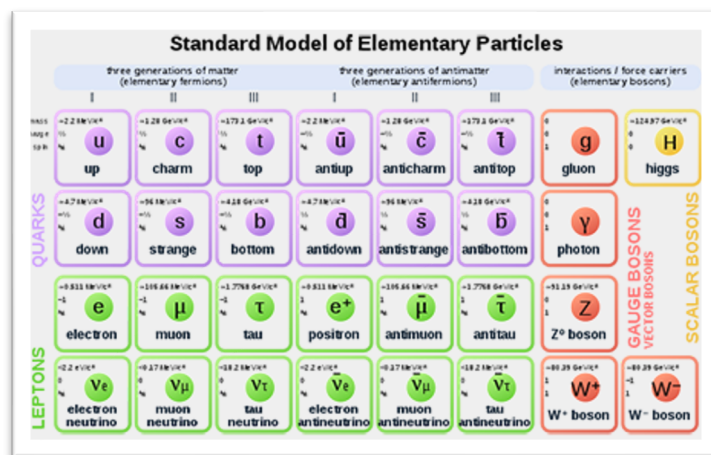
- **CERN:** Home to the Large Hadron Collider (LHC), where the Higgs boson was discovered.
- **Fermilab:** Known for high-energy experiments that explore the properties of quarks and leptons.
- **Shanghai Synchrotron:** A leading facility in China that advances research in particle physics, materials science, and biology through its powerful synchrotron radiation sources.

Why Study Particle Physics?

- **Scientific Curiosity:** Tackle big questions about the universe.
- **Technological Innovation:** Contribute to advancements that have practical applications, such as the creation of the World Wide Web.
- **Critical Thinking Skills:** Develop strong analytical and problem-solving abilities.

Join the Adventure:

By participating in this masterclass, you'll be part of a global quest to uncover the deepest secrets of the universe. Equip yourself with knowledge and skills that can lead to exciting opportunities in science and beyond. You'll get to work with physicists from CERN, Fermilab and the Shanghai Synchrotron to understand particle physics, quantum mechanics and their engineering applications.



Related Fields and Applications:

Particle physics is foundational to many fields including the following:

- **Medical Imaging and Treatment:**
 - MRI and PET scans
 - Radiotherapy
- **Information Technology:**
 - Data processing and storage
- **Materials Science:**
 - Synchrotron light sources
 - Superconductors
- **Security:**
 - Particle detectors
 - Radiation detection
- **Energy:**
 - Nuclear fusion research
 - Particle beam technology
- **Industrial Applications:**
 - Accelerator technology
 - Ion implantation
- **Space Exploration:**
 - Radiation shielding
 - Astrophysics research

Programme: September, 2024

Date	Time	Activity
10 September		<i>Registrations close. Local school locations confirmed with teachers.</i>
19 September	08:00-08:30	<i>Setup and preparations for start of the masterclass</i>
	08:30-09:30	<i>Introduction, objectives and lecture</i>
	09:30-10:30	<i>Activity 1: quark workbench, fundamental particle cards</i>
	10:30-10:45	<i>Break</i>
	10:45-12:30	<i>Activity 2: iSpy and CIMA – identifying fundamental particles</i>
	12:30-13:30 13:30-14:30 14:30-15:30	Shanghai only ... <i>Lunch & travel to Shanghai synchrotron Shanghai Synchrotron Lecture and Tour Arrive back at schools Arrive back at schools</i>
1 week		<i>Complete the research task and enter results into CIMA</i>
26 September	08:30-09:30	<i>Introductions to Physicists from CERN and FermiLab, collective results explained and explored, Q&A.</i>
2 weeks		<i>Completion certificates issued on completion of activities.</i>

Venues:

The sessions will be conducted via online lectures, but schools may choose to have students join together in a classroom to work collaboratively together on the activities and research projects. School near to each other might consider meeting together.

You are encouraged to work in small groups. The room will need good WiFi and a screen/camera for the online lecturers. A teacher should be present to support.

Requirements:

- Students will need a laptop, notebook, ruler and pencils/pens and protractor.
- Activities cards will be emailed to students/teachers before the masterclasses and should be printed out.
- Access to good WiFi and internet.

Software Systems:

Students will need to ensure they have access to the following sites for the masterclass:

Quark Workbench	https://web.quarknet.org/activities/qwbench/puzzle5.html
iSPY	https://www.i2u2.org/elab/cms/ispy-webgl/
CIMA	https://www.i2u2.org/elab/cms/cima-wzh/

Outcomes:

Students will receive an official certificate of achievement for the masterclass if they ...

- Attend both masterclass sessions, and
- Complete the research task assigned in during the sessions.
- Students interested in further research in applications of this field can reach out to the EdFutures team – we have some great programmes in Heavy Ion Particle Therapy and workshop in Xiamen with the Boron Neutron Capture Facility.



Application:

The number of spaces available on the programme is strictly limited. Interested students are encouraged to apply early by completing the application using the link on the QR code here.

It is recommended that you participate in this masterclass as a group with other students from your school, but individual participation is possible. You will need to have your school's permission, a room allocated and teacher to supervise you for the two sessions.

There is no cost to this programme.

To register for the programme, please click on the link or scan the QR code at the right.

You must have your school's and parent's permission before applying.

<https://forms.office.com/r/6TxCA5Hwpg>

